

ployed. A number of tables give some interesting details relative to the number of miners, the machinery in use, and its value, from which may be gathered some idea of the extent and importance of the several gold fields in the colony. Of these fields, that of Ballarat appears at the head of the list, showing a total number of miners employed of 13,892, the approximate value of mining plant being 516,825*l.*; 134½ square miles of auriferous ground are actually worked upon, and 189 auriferous reefs have been proved. In this district also occur the deepest shafts, two of which reach the depths of 866 ft. and 900 ft. respectively. The price of Ballarat gold varies from 3*l.* 13*s.* 6*d.* to 4*l.* 2*s.* 6*d.* per ounce, the latter appearing to be the highest price obtained for any gold in the colony. In this mining district 78,502 tons 10 cwt. of quartz were crushed during the last quarter of the year, yielding 5 dwt. 19·42 gr. of gold per ton; and the average yield in the different gold fields being very variable. But in considering the relative importance of each district, we are reminded by Mr. Brough Smyth, the Secretary for Mines, that the table relating to machinery should be examined and compared, from which it appears that it is not always the mines that show the greatest yield of gold which give the largest return to proprietors. An interesting feature in these reports is the description by Dr. F. von Mueller (Director of the Botanic Garden of Melbourne) of certain new vegetable fossils which are met with from time to time in the deep auriferous drifts of older Pliocene age. These consist of the fruits of plants which, according to Dr. Mueller rejoined in a milder climate, and displayed forms of tropical grandeur now foreign to the spot. Five genera are described and illustrated with beautiful lithograms. Of these, among fossil genera *Phymatocaryon* comes nearest to the extinct *Cupanoides*, *Tricarpellites*, and *Wetherellia* of the London Clay. Another genus, *Trematocaryon*, bears no very close alliance with any genus among living or fossil plants. The remaining genera are *Rhytidotoeca*, with some affinities to *Chloroxylon* and *Flindersia*, *Plesiocapparis*, the real affinity of which is doubtful, and *Celyphina*, which appears to belong to the order of Proteaceæ. We are glad to learn that many other fossil remains have been secured, and are now under examination by Dr. Mueller. For the collection of these fossils palæontologists are indebted to the enlightened zeal of Mr. John Lynch, mining surveyor and registrar. When one looks over the long list of surveyors and registrars employed by the Colonial Government in gathering statistics, we can only hope that some, if not all, of these gentlemen will follow Mr. Lynch's example, and thus be the means of increasing our knowledge of the "old world" of Australia.

J. G.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.]

The Rigidity of the Earth and the Liquidity of Lavas

I WAS glad to see the powerful argument in favour of the solidity of the earth which Sir William Thomson has deduced from its great rigidity, republished in *NATURE* of January 18, since, though never attacked, it has been ignored by those who hold a contrary view. In a lecture before the Royal Institution in May 1867, I appealed to it in support of the notion which I have long maintained of a globe solidified from the centre; and I remember that for that and for other heresies in my lecture I was sharply attacked in the *Geological Magazine*, and in turn defended myself as best I might in the same magazine for February 1868. I there said that "the conclusions of Hopkins from the phenomena of precession and nutation, the investigations of Archdeacon Pratt on the crushing effect of immense mountain masses like the Himalaya, and the deductions of Sir William Thomson from the phenomena of the tides, showing the great

rigidity of the earth, are so many concurrent evidences that our planet, if not actually solid to the centre, has a crust far thicker than can be accounted for by the theory of a liquid globe, covered only with a crust resulting from superficial cooling." This discussion of the subject at that time seems to have had the effect of bringing to the front the defenders of the latter theory, which, in the popular mind at least, has a mythological rather than a scientific foundation. It was, therefore, well that Sir William Thomson should repeat his argument.

Mr. Fisher has in this connection, in *NATURE* for January 25, referred to the distribution of fluid ignited matter within the earth, and to the relation of volcanoes to great lines of elevation, which would seem to show that the local distribution of such matter may be connected with these lines. He says, "I have suggested that this fluidity may arise from a diminished pressure beneath mountain ranges, owing to their mass being partly supported by the lateral thrust which has upraised them," and adds, "If any of your correspondents can propose another explanation of this remarkable coincidence compatible with the supposition of a rigid globe it would be interesting to know it."

My present object in writing is to call attention to the explanation proposed by me in the *Geological Magazine* for February 1870, conceiving, with Archdeacon Pratt, that the condition of things beneath a great mountain mass is one of increased rather than of diminished pressure. I there said, "Pressure, which in the first case, that of simple fusion of anhydrous materials, prevents liquefaction by preventing expansion, in the second case (that of igneo-aqueous fusion, or liquefaction at high temperatures, by the aid of a small portion of water, as maintained by Scrope, Scheerer, and Elie de Beaumont) on the contrary, favours liquefaction by promoting the solution of the water-impregnated mass." As Sorby has shown, a conversion of mechanical into chemical force appears in the increase of solubility under pressure. In other words, pressure prevents fusion, when, as in most instances, it is a process of expansion; but favours solution, which is, with few exceptions, a process of contraction.

"Now since I place the seat of volcanic action in a region where solution, rather than simple fusion, is the cause of liquidity, I am led to consider pressure as one of the efficient causes of the liquefaction of rocks, and to regard its diminution as leading to solidification." (See also *Amer. Jour. Science*, ii., 1. 27).

Montreal, June 21

T. STERRY HUNT

Fouling of the Nile

THERE is an account—of which I have unfortunately lost the reference—of the Nile becoming crimson and putrid, and its fish being killed, during the historic period, seemingly by microscopic algae. If any learned contributor could tell me where I can find this fact recorded, and could give me any details of similar phenomena, he would do me an especial kindness.

Chester, July 8

C. KINGSLEY

Volcanoes of Central France

AFTER carefully reading through the two extracts from Sidonius and Avitus contained in your number of May 30, my impression was that notwithstanding some manifest improbabilities, the conclusion was inevitable that earthquakes and other volcanic phenomena had actually been witnessed at Vienne. However, after examining all the facts of the case, a theory has occurred to me by which both accounts may be consistently explained without any such phenomena having occurred there at all. It would only remain to be shown that my supposed facts are not contradicted by evidence actually on record.

First, as to the persons:—The whole matter centres in the great Gallic family of Avitus, belonging to Auvergne. The most distinguished member of this family was Marcus Mæcilius Avitus, a person of so much importance that in the year 455 he became Emperor, but so little fortunate that in October 456 he was conquered and driven from the throne. He was allowed to become Bishop of Piacenza, but fearing for his life, returned to Auvergne and took refuge in the Church of St. Julian.* We find shortly afterwards two members of this family in possession of the See of Vienne, father and son, in succession, and the latter was the author of our Homily.

It seems, therefore, highly probable that the bishopric was in the gift of the family, or in some way dependent on it. In the year 463 we first find St. Mamertus in possession of the

* According to Gibbon he died on the way; the one certain fact is that he was buried there.

See, and his brother C. *Ecdicius* Mamertus seems to have been closely connected with it; indeed, he seems to have composed music for the choir. We are warranted in conjecturing that this family must have had intimate relations with that of Avitus. The name of the author of the Homily is A. *Ecdicius* Avitus; Sidonius Apollinaris was son-in-law of the Emperor Avitus, and his intimacy and correspondence with "Lord Patriarch Mamertus" confirm the supposition.

We have seen that M. M. Avitus went to Rome as Emperor, A.D. 455. The first time we hear of Mamertus as Bishop of Vienne is A.D. 463. What, then, is the probability of the following facts?

When Avitus went to Rome, he took with him many of his intimate friends and connections, and among them St. Mamertus. He obtained for Mamertus some Italian See, of which the principal town was situate at no great distance from Vesuvius. It was walled, had a large forum, and was partly inhabited by the nobility of the country. Upon the expulsion of his patron, Mamertus exchanged to the See of Vienne, or obtained that See by some other means. During the short time he was in Italy he witnessed those earthquakes and showers of ashes described in the letter and the Homily.

Assuming these facts, how will they agree with the statements in these documents, and with the known history of Vesuvius?

It is clear, from the letter of Sidonius, that the reason why the people of Auvergne observed the Rogations was not the fear of earthquakes, but of the incursions of the Goths, against whose advances they formed the chief barrier; they lived in the midst of the "surrounding terrors," yet Sidonius himself had to make inquiries and get information (*Sciscitatio*) in order to become acquainted with the volcanic phenomena: he nowhere says that "the city divinely committed to Mamertus" was Vienne, and all the circumstances are connected with Mamertus personally, and with a town only through him.

St. Avitus succeeded his father A.D. 490, and died A.D. 525. At what precise date he wrote the Homily I suppose is unknown; it may, perhaps, have been written before he was Bishop. The date of his birth seems to be unknown, but he may very well have been old enough to have been with his father in Italy, and as a youth have witnessed the phenomena that were seen by Mamertus; and in the congregation that listened to the Homily, there may still have been "many" who had been there also (with the army?), and had also seen them.

The words "at that time" mean that the earthquakes, &c., occurred at the same time with the attacks of the Goths on the inhabitants of Auvergne and Vienne.

One astonishing circumstance is that the Rogations, though instituted (in Gaul at least) by Mamertus, say between 456 and 463, had already obtained in "nearly the whole world;" evidently no such rapid and wide extension could be due to the fear of earthquakes; but it is easily understood, if they were considered to be a protection against the attacks of barbarians; the time of their celebration shortly before Whitsuntide would, I suppose, be about the time of preparation for the usual summer campaign.

But how account for a Bishop of Vienne instituting at Vienne a ceremony which is alleged to have been occasioned by events that happened in Italy? Thus:—Mamertus, who had no previous knowledge of volcanic action, would be greatly struck by what he saw; and even to the Italians these manifestations were probably a novelty. Vesuvius had been comparatively quiet for 200 years, and these (by hypothesis) were among the first intimations of that renewed fury which reached its climax in 472, and is mentioned by Procopius (I have no access to his work).*

Struck with terror, the idea of the Rogations occurred to him while in Italy, possibly he may have instituted them there; but it agrees better with the claim of Vienne to suppose that before he had the opportunity of carrying out his idea, he found himself again in Vienne, and first instituted them there, not against earthquakes, but against the barbarians.

The two things together, the earthquakes and the wars, suggested to him the possible approach of the awful time indicated by Christ (Matt. xxiv. 15)—"Cum ergo videritis abominationem desolationis," &c.; hence the "abominabilia" and the "doom of desolation" of the Homily. The "magna tribulatio" would well agree with the constant wars, and the "ineffable distress" occasioned by them.

Norwich, June 5

HENRY NORTON

* A few days after writing this I read the passage in Procopius, and found that he expressly attributes the institution of Rogations to the action of Vesuvius.

The Wanderings of the Esquimaux

IT is very gratifying to find that Mr. Howorth, whilst holding the position he has taken up with augmented force, has accepted, in the same kindly spirit in which they were written, the observations on the migrations of the Esquimaux which I was led to make after reading his very excellent letter in NATURE of May 9.

Mr. Howorth now brings forward the language of the Esquimaux in support of his views. This may be a strong point, although, if I remember rightly, one or two distinguished ethnologists think differently. As for myself, having little or no knowledge of languages, I can express no opinion one way or other.

Open as I am and shall be to conviction, and ready to give up my opinion cheerfully if proved wrong, I find that so far, the able arguments brought forward by Mr. Howorth have not in the slightest degree unsettled my belief in the truth of the Esquimaux tradition, communicated through interpreters whose competence I proved in a very satisfactory manner, at the same time that I ascertained the reliability to be placed on information transmitted from one to another by the Esquimaux. This I did by comparing information given by the natives of Repulse Bay, through my interpreter, with portions of the narratives of Arctic explorers of distinction (with which it agreed very closely) written in the one case more than twenty, and in the other more than thirty years before; of course neither the Esquimaux nor the interpreter knew what was in these narratives.

Mr. Howorth quotes numerous authorities, and I have no doubt does it so correctly that there is no necessity to look them up. These I shall now endeavour to answer, and as nearly as possible in the order in which they appear in his letter.

I do not think that the fact of the "Arctic Highlanders" building "stone igloos instead of snow huts," or their "ignorance of boats, either kayaks or oomiaks," makes any "broad distinction" between these people and the "American Esquimaux."

In the far west, that is, from Behring Strait to the Mackenzie River, the Esquimaux live in wooden houses during winter, probably because driftwood is abundant. They also have both kayaks and oomiaks.

As you go eastward and get near the Coppermine River, snow-huts form the winter shelter, probably because little or no wood is to be found, and a stone house without fuel to make a fire, is, as I know by experience, much colder and more comfortable than a snow-house under the same circumstances. The food of these natives is principally reindeer, musk cattle, and fish, with some seals, but neither whales nor walrus, as far as I could learn, to give fat for fuel. Here, also, the oomiak or large luggage boat disappears, it may be because the Esquimaux are less numerous, more scattered, and live in smaller communities, and do not require it. Another reason may be that the sea is more ice-encumbered. The kayak is, however, still in use, and when it is requisite to transport a family or a heavy load across water, two or more of these are fastened together, poles or paddles laid across them, and thus a kind of platform is constructed, which will carry very considerable weights in perfect safety.

This state of things prevails as far eastward as the great Fish River, Boothia, Gulf Committee, Repulse and Hudson Bays, but as the Esquimaux travelled northward to latitudes 76° and 77° by the route I have supposed them to do, as described in a former letter, the difficulty of building kayaks would be increased in consequence of scarcity of wood to make the frames.* The necessity for them would also become less, as the sea became less free from ice, and if, as I suppose, they chiefly hunted and lived upon reindeer and musk cattle. The usual season for killing seals is before the ice breaks up, so no kayak is required for that purpose.

From the description given me of the numerous "moss-grown ruins of deserted huts" seen near Smith Sound and on the Parry Islands, I am led to believe that many of them were not dwelling places at all, but the ruins of large stone "caches," such as are found in many places on the shores of America, where the natives have collected a quantity of provisions, round which stones are built in a very solid manner as a protection against the attack of the fox, the wolf, their own dogs, and, worst of all, the wolverine.

Let me now say a few words about the Arctic Highlanders of

* In 1846 the Esquimaux of Repulse Bay had plenty of wood, but in 1854 many of them, who had been hoarding up seal skins for the purpose, could not build kayaks, because they had no wood to make the frames of.